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Dairy Herd Improvement Letter

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NATIONAL COOPERATIVE
DAIRY HERD IMPROVEMENT
PROGRAM
A dairy recordkeeping plan
for every herd

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Dairy Herd Improvement Letter

PREDICTED DIFFERENCES CAN BE DIRECTLY COMPARED ACROSS TIME

By Rex L. Powell [1]

The U.S. Department of Agriculture provides estimates of genetic transmitting ability for dairy sires in the form of Predicted Differences (PD's). The base or zero point for PD's is the merit of the average sire for the cows included in the first Modified Contemporary Comparison (MCC) Sire Summary, Fall 1974. Calving dates ranged from 1960 to 1974 and averaged about 1968. A zero PD bull then is an average sire for cows calving about 1968, depending on breed. The exact date is unimportant, but the fact that all MCC sire summaries to date have been to the same base is important. PD's computed with that base are correctly referred to as PD74. However, in the absence of another base, the 74 is often omitted.

The procedure for computing PD74 accounts for genetic differences both within and across time. The formula can be written in a number of ways, but for purposes of this discussion,

$$PD74 = R(D - MCA + SMC) + (1-R)GA$$

where: R is the Repeatability of the progeny test,
D is the weighted average production for daughters,
MCA is the weighted average production for modified contemporaries,
SMC is the weighted average sire merit for modified contemporaries, and
GA is the genetic group average or the average merit of bulls with a similar pedigree.

A bull is expected to have the same PD74, regardless of when he is evaluated. For a later evaluation, D-MCA would be expected to be smaller because the modified contemporaries are sired by genetically superior bulls compared to earlier contemporaries, but this should be offset by the increase in SMC. Thus, PD's for a given bull are expected to be the same whenever he is summarized. Also, PD's for different bulls are directly comparable even though the bulls were summarized at different times. Since differences in SMC between sires are accounted for, sires are fairly compared even though they may have been evaluated in herds that have used sires of greatly different quality. Accounting for competition is a feature of PD74 and necessary to evaluate all bulls relative to the common base.

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[1] Research geneticist (animal), Animal Improvement Programs Laboratory, Animal Science Institute, Beltsville Agricultural Research Center, Beltsville, Md. 20705.

Expected genetic differences among the sires themselves are also considered by PD74. These differences are determined from a bull's pedigree through the use of GA. GA has, in part, accounted for a genetic trend in sires evaluated because younger bulls tend to have better pedigrees than older bulls. However, SMC is an essential element in accounting for changes in genetic merit of contemporaries across time.

Key features of PD74 are the consideration of competition and the expected merit of the sire as suggested by the pedigree. These features are necessary to capitalize on the benefits of the common genetic base. Under PD74, sires can be compared directly and fairly regardless of the date of summary, level of competition, or ancestry.

HOW FAST SIRES ARE IMPROVING, BY BREED

By Rex L. Powell [1]

The average Predicted Difference (PD) for sires of cows calving each year should be better than the previous year, if progress is being made. All USDA-DHIA PD's are relative to the base established in 1974 and are correctly referred to as PD74. However, in the absence of another base, the 74 is often omitted. Measures of the effectiveness of the overall sire selection efforts of the industry can be obtained by monitoring annual changes in average PD74. The results should also provide guidance as to how much sire selection standards need to be raised annually to keep pace with industry progress.

The average PD's were studied for sires of first lactation cows on Official DHI test calving from 1973 through 1978. Only first lactations were used in order to provide figures more reflective of recent decisions. The use of later lactations would dilute the higher recent levels of sire merit. Table 1 gives the average PD's for 1973 and 1978 and the annual change for intervening years for milk, fat, and dollars. PD dollars (PD\$) is a combination of PD milk (PDM) and PD fat (PDF) according to the national average milk price in 1979. Thus, PD\$ = (\$0.0653 x PDM) + (\$1.42 x PDF). All PD\$ were computed by this formula. Changes from year to year more clearly show the changes (progress) taking place than would the presentation of annual averages.

The annual changes are not uniform across or even within breeds but are predominately positive. Some fluctuations are due to limited numbers of cows and sires in some breeds. The fluctuations are smaller in Holsteins, probably because of the larger number of cows. The sires of later lactation cows, representing a number of years of first calvings, would smooth out the year-to-year variation from sires of first lactation cows. In these data, first lactations were 25 to 30 percent of all lactations.

The average sire is genetically better each year. The table gives the average annual changes in PDM, PDF, and PD\$. Each year dairy farmers need to increase the average PD's of sires used by those amounts, just to keep pace with national progress.

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[1] Research geneticist (animal), Animal Improvement Programs Laboratory, Animal Science Institute, Beltsville Agricultural Research Center, Beltsville, Md. 20705.

Table 1.--Averages in 1973 and 1978 and annual changes for Predicted Difference milk, fat, and dollars of sires of first lactation cows

Breed	1973 average	1978 average	Change from previous year for 1974	1975	1976	1977	1978	Average annual change
			Milk (lb)					
Ayrshire------------	163	343	-14	+69	+69	+35	+21	+36
Brown Swiss---------	297	501	0	+36	+68	+33	+67	+41
Guernsey------------	120	425	+30	+49	+51	+95	+80	+61
Holstein------------	177	552	+87	+78	+58	+55	+97	+75
Jersey--------------	282	633	+80	+95	+69	+35	+72	+70
Milking Shorthorn---	260	461	+96	+120	-4	-14	+3	+40
			Fat (lb)					
Ayrshire------------	5.8	11.0	-0.8	+1.9	+1.7	+1.5	+0.9	+1.0
Brown Swiss---------	8.4	17.8	+.5	+1.0	+3.8	+1.1	+3.0	+1.9
Guernsey------------	4.8	15.6	+2.1	+2.1	+1.3	+2.7	+2.6	+2.2
Holstein------------	2.5	11.8	+2.7	+1.7	+.7	+1.3	+2.9	+1.9
Jersey--------------	7.8	20.8	+2.9	+3.9	+1.7	+1.1	+3.4	+2.6
Milking Shorthorn---	10.6	21.4	+4.0	+4.7	+.3	+1.0	.8	+2.2
			Dollars					
Ayrshire------------	19	38	-2	+7	+7	+4	+3	+4
Brown Swiss---------	31	58	+1	+4	+10	+3	+9	+5
Guernsey------------	15	50	+5	+6	+5	+10	+9	+7
Holstein------------	15	53	+10	+7	+5	+5	+11	+8
Jersey--------------	29	71	+10	+12	+7	+3	+10	+8
Milking Shorthorn---	32	60	+12	+14	0	+1	+1	+6

HAVE YOU RAISED THE CREDENTIALS OF YOUR SERVICE SIRES?

By Rex L. Powell and H. Duane Norman 1/

A dairy farmer has many factors to consider when choosing a service sire for his cows and heifers. Availability and price of semen may limit his choices, and interest in type characteristics will affect his decision, but the major factor should be the level of sire merit for improving production. The measure of a sire's genetic transmitting ability for production is the USDA Predicted Difference (PD) for milk and fat. Each dairy farmer should be aware of where the service sires he uses will place his herd relative to all herds in the country. Then he can decide if that position is satisfactory or if he would like to make more rapid genetic progress.

We will predict the relationship of service sire PD and resulting herd ranking by examining recent data on sires of first lactation cows. Average PD's of sires of first lactation cows calving in 1978 are in table 1. The average month of calving was July. With a 9-month gestation and an average age at first calving of 27 months, the average conception date would be 3 years before the calving date. Thus, the averages in table 1 represent the service sires used in 1975, averaging about July 1975. If we want to predict the average PD of a service sire in July 1980, we must apply 5 years of genetic progress. Average annual increases in PD's are in table 2. We assume that the increases from 1970 through 1975 will continue through 1980. As an example, the average annual increase for PD milk of Holstein sires was 75 pounds. Then the expected service sire PD milk in July 1980 is 552 + (5 x 75) = +927. Coincidentally, this is fairly close to the average for Holstein sires in active artificial insemination (AI) service.

Table 3 combines the distribution of herd average PD's for sires of first lactation cows in 1978 (service sires in 1975) and the expected increases over the 5-year period. PD dollars is a combination of PD's for milk and fat according to average milk prices from the previous year. PD dollars equals PD milk times \$0.0653 plus PD fat times \$1.42 according to the national average milk price in 1979. This table can be read two ways. Given a level of PD, one can see where that would place a herd relative to other herds. Also, given a desired ranking for a herd, one can select the minimum PD's expected to achieve that rank.

Selection of sires on PD dollars should result in the greatest increase in income. Dairy farmers should select the highest PD dollar bulls rather than setting some minimum acceptable level if maximum progress is to be made.

1/ Research geneticists (animal), Animal Improvement Programs Laboratory, Animal Science Institute, Beltsville Agricultural Research Center, Beltsville, Md. 20705.

If minimums are used, table 3 can be a guide to establishing minimums. Such standards need to be updated frequently. This table will become outdated and misleading if values are not revised annually.

Two national dairy magazines and various breed and extension publications rank active AI bulls on PD dollars or on an index that also considers type. Selecting a number of bulls from near the top of such lists is recommended to insure a high average PD and to benefit from increased production.

Table 1.--Average Predicted Differences for sires of first lactation cows calving in 1978

Breed	Predicted Difference	
	Milk	Fat
	Lb	Lb
Ayrshire	343	11
Brown Swiss	501	18
Guernsey	425	16
Holstein	552	12
Jersey	633	21
Milking Shorthorn	461	21

Table 2.--Average annual increases in Predicted Differences of service sires, 1970-75 [1]

Breed	Annual increase	
	PD milk	PD fat
	Lb	Lb
Ayrshire	36	1.0
Brown Swiss	41	1.9
Guernsey	61	2.2
Holstein	75	1.9
Jersey	70	2.6
Milking Shorthorn	40	2.2

[1] Data are PD's of sires of first lactation cows calving in 1973 through 1978. A 3-year delay is assumed between conception and first calving by a resulting daughter.

Table 3.--Expected minimum average Predicted Differences for milk, fat, and dollars for service sires in July 1980 for herds to be in various top percentages of all herds

Top percentage for herds		Ayrshire	Brown Swiss	Guernsey	Holstein	Jersey	Milking Shorthorn
2	milk lb	1,079	1,381	1,367	1,530	1,456	1,179
	fat lb	31	56	53	44	55	57
	dollars	110	166	154	159	170	159
5	milk lb	923	1,229	1,136	1,404	1,361	1,071
	fat lb	29	51	46	40	52	54
	dollars	98	154	144	146	164	147
10	milk lb	817	1,124	1,040	1,285	1,282	931
	fat lb	27	47	42	36	47	49
	dollars	86	141	132	134	153	135
20	milk lb	703	972	930	1,150	1,177	820
	fat lb	23	41	36	31	43	40
	dollars	75	123	114	120	141	114
30	milk lb	615	856	828	1,052	1,095	733
	fat lb	21	35	32	27	40	36
	dollars	67	108	103	110	131	101
40	milk lb	550	763	748	967	1,026	663
	fat lb	18	31	29	24	36	32
	dollars	59	98	94	100	122	96
50	milk lb	467	672	681	884	960	602
	fat lb	16	28	26	21	33	30
	dollars	51	86	86	91	114	85
70	milk lb	319	483	538	705	783	458
	fat lb	12	20	20	16	28	26
	dollars	43	63	67	72	95	69
90	milk lb	48	165	337	405	478	221
	fat lb	4	10	14	8	15	14
	dollars	10	32	45	43	59	39

INCLUDING PEDIGREE INFORMATION IN PREDICTED DIFFERENCE

By Rex L. Powell and Bennet G. Cassell [1]

Only pedigree information is available as an indication of potential for transmitting production when buying a bull calf. Production information on daughters of the bull becomes available when he is 5 or 6 years of age. The two estimates of the bull's merit - one from the pedigree and one from the daughters - are combined by USDA into a single estimate called Predicted Difference (PD). The purpose of a PD is to predict the future daughter merit for a bull. Adding pedigree information to past daughter performance aids the prediction.

PD is calculated as $R(\overline{MCD}) + (1-R)GA$, where R is the Repeatability of the progeny test expressed as a decimal, $\overline{MCD}$ is a measure of average daughter performance, and GA is the genetic group average. Pedigree information affects PD through GA. Let's examine the PD formula and see how R affects the impact of GA on PD. The weight to GA (i.e., 1-R) decreases as R increases. However, pedigree information for a bull is never discarded. It merely becomes less and less important relative to an increasing number of daughter production records. The PD formula can also be written as $GA + R(\overline{MCD}-GA)$. $R = 0$ and PD is GA for a bull with no daughters. PD can move away from GA as daughter information becomes available. Daughter performance predominates in determining PD when R is very high.

Pedigree Index (PI) is one-half the sire's PD plus one-fourth the maternal grandsire's PD. Bulls are assigned to categories according to the amount of pedigree information available (sire and maternal grandsire, sire only, maternal grandsire only). The first two categories are further separated for Holstein bulls initially sampled through artificial insemination (AI) or non-AI. Bulls are assigned to genetic groups within categories by their PI's for milk. For example, all AI-sampled bulls with PD's on both ancestors are ranked from high to low on PI milk. Then bulls with similar PI's are assigned to the same genetic group. PI is forgotten after genetic groups are formed. GA is determined by the average daughter performance ($\overline{MCD}$) for all bulls in the group. Bulls without a PI are all placed in one group.

Two points from the previous discussion are especially important. First, the weight to GA depends on the amount of daughter information (R). Second, PI is used only for placing a bull in a group; GA is determined by daughter performance of bulls in that group.

The value of (1-R)GA for milk was added to Sire Summary lists beginning in the spring 1977. Although PD's should be the major columns of interest, the (1-R)GA indicates how important the group information was in arriving at the PD milk. The corresponding value for fat is not provided because of space limitations. If a bull has a PD milk of +1,226 and (1-R)GA is +112, we know that 112 pounds of the PD came from using pedigree information, and the PD from daughters alone would have been +1,114. The GA is about 112/(1-R) or +622, because R = 82 percent. The $\overline{\text{MCD}}$ is about +1,114/0.82 or +1,359. Providing (1-R)GA has been educational because many people would otherwise overestimate the effect of the pedigree grouping.

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[1] Research geneticist (animal) and dairy husbandman, respectively, Animal Improvement Programs Laboratory, Animal Science Institute, Beltsville Agricultural Research Center, Beltsville, Md. 20705.

Research has shown a high relationship between GA and $\overline{\text{MCD}}$. Use of pedigree information through GA is like having a few extra daughters. Just as a few daughters may not reflect the performance of all daughters, so GA may not always give the same picture as all daughters. But both sources of information contribute to a more accurate prediction of future daughters.

The incorporation of GA into the PD formula has been especially valuable for bulls with low Repeatabilities. The value of the pedigree information is equal to about six to eight daughters in as many herds. Thus, the use of GA can be more valuable in predicting future daughter performance than can a hundred daughters in a single herd. The (1-R)GA is only supplemental information. The PD is what should be emphasized because (1-R)GA is already included in the PD.

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